**Remarks:**

1. Applicant respectfully requests entry of this Preliminary Amendment, which is being filed within three months of the filing date of the above-cited application.

2. Reference to **FIG. 6** was deleted from the Specification as originally filed and, as a result, paragraph [0036] was deleted from the Specification.

3. In paragraph [0048], the first three sentences were deleted and the reference to **FIG. 6** in sentence 4 was replaced with a reference to **FIG. 5**. In paragraph [0049], the definite article in the third line was replaced with the indefinite article "an". In paragraph [0051], reference to **FIG. 6** was replaced with reference to **FIG. 5**. In the subsequent paragraphs [0054] to [0057] the reference designations of the drawings were amended to match the reference designations on the amended drawings.

4. In the drawings, the angles $\boldsymbol{\theta}$ and $\boldsymbol{\beta}$ were added to **FIG. 5**. These angles are discussed in the Specification as filed in paragraphs 20 and 21 on pages 9 and 10 and in paragraphs [0049] - [0052] on pages 17 - 19. No new matter has been introduced with these amendments.

Respectfully submitted,

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Enclosed:
Marked-up copy of amendments
Marked-up drawings
New formal drawings

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**[0038]** FIG. [7] 6 shows a truncated cone hub element of a first alternative embodiment according to the present invention.

**[0039]** FIG. [8] 7 shows a tapered triangular tapered tube hub element of a second alternative embodiment according to the present invention.

**[0040]** FIG. [9] 8 shows a six-triangle strutted frame hub element of a third alternative embodiment according to the present invention.

**[0041]** FIG. [10] 9 shows a four-triangle strutted frame hub element of a fourth alternative embodiment according to the present invention.

**[0042]** FIG. [11] 10 shows a partial view of geodesic structure according to the present invention, constructed of tapered triangular tube hub elements and covered with a skin.

**[0043]** FIG. [12] 11 shows a plurality of strutted frame elements according to the present invention, connected to each other with an adjustable coupler.



**[0044]** FIG. [13] 12 shows an adjustable coupler to adjustably hold the strut ends of strutted frames in position within a structure constructed according to the present invention.

**[0045]** FIG. [14] 13 is an illustration of a map of the earth that was projected onto a sphere, with vertexes and triangles arranged according to the present invention and cut along edges of several triangles to create a flat map.

## DETAILED DESCRIPTION OF THE INVENTION

**[0048]** [**FIG. 6** shows an orthogonal view of a partial cross-section of the geodesic dome **100** constructed according to the first embodiment of the invention. Several hub elements $\mathbf{5}_A$, $\mathbf{5}_B$, and $\mathbf{5}_C$, each with a vertex $\mathbf{V}_A$, $\mathbf{V}_B$, and $\mathbf{V}_C$, respectively, and an internal angle $\boldsymbol{\beta}$, are shown arranged around a diameter of the dome **100**. The overlap between adjacent hub elements **5** is the maximal overlap, whereby the outer perimeter of hub element $\mathbf{5}_A$, for example, approaches the vertexes of adjacent hub elements $\mathbf{5}_B$, and $\mathbf{5}_C$.] Also shown in **FIG.** [**6**] <u>**5**</u> is an angle of structure $\boldsymbol{\theta}$, also referred to as an external angle $\boldsymbol{\theta}$ and, when referring to this first embodiment, a dome angle $\boldsymbol{\theta}$. For purposes of illustration, the radius **R** of the dome **100** is 5 m, the dome angle $\boldsymbol{\theta}$ is 10°, and the number of hub elements **5** and the strut length **SL** are to be calculated.

**[0049]** To calculate the number of hub elements **5** needed for a semisphere, the solid angle of 360° is divided by the angular deficit $\boldsymbol{\alpha}$. Knowing that the dome angle $\boldsymbol{\theta}$ is 10°, [the] <u>an</u> internal angle $\boldsymbol{\beta}$ is then equal to (180° - $\boldsymbol{\theta}$)/2, which is 85°. The angular deficit $\boldsymbol{\alpha}$ is equal to 360° (1 - sin $\boldsymbol{\beta}$), which is 1.4°. The number of hub elements **5** required is then 360°/1.4°, that is, 257 hub elements **5**. To calculate the hub length **L**, shown in **FIG. 5**, we first calculate the strut length **SL**, that is, the distance between vertexes **V** of the hub elements **5**. As can be seen in **FIG. 7**, the strut length **SL** is equal to *sin* $\boldsymbol{\theta}$ x $R_A$, which, in this particular embodiment, is (0.174)(5 m) = 0.87 m. The minimum hub length $\mathbf{L}_{min}$ is **SL/2** and the maximum hub length $\mathbf{L}_{max}$ is slightly shorter than the strut length **SL**. With hub length $\mathbf{L}_{min}$ and hub elements **5** that are arranged so as to just tangentially contact adjacent elements **5**, the geodesic dome **100** comprising the **257** hub elements **5** described above will have a dome angle $\boldsymbol{\theta}$ of 10°, a radius **R** of 5 m, an angular deficit $\boldsymbol{\alpha}$ of 1.4°, and strut length **SL** of 0.87 m. Any amount of overlap between adjacent hub elements **5** must be added to the minimum hub length to determine the actual hub length **L**.

**[0051]** In the example described above, the dome angle ***θ***, which corresponds to the external angle ***θ***, was known to be 10°. The external angle ***θ*** is the amount of deflection between one leg of the hub element **5** and an extended line from the other leg of the same hub element **5** at the vertex **V**. As can be seen in **FIG.** [6] 5, (2 x sin ***β***) + ***θ*** is equal to 180°. If the angular deficit **α** of the hub element **5** is known, the external angle ***θ*** of the hub element **5** and the angle of structure ***θ*** of the structure can be calculated because, based on simple trigonometric equations, it is known that sin ***β*** equals (1- ***α***/180°). So, for example, if the angular deficit ***α*** is approximately 1.4°, the dome angle ***θ*** of the dome **100** is approximately 10°.

**[0054]** **FIGS.** [7, 8, 9, and 10,] 6, 7, 8, and 9 illustrate other types of hub elements that can be used to construct further embodiments of a geodesic structure according to the present invention. **FIG.** [7] 6 shows a tapered cone **11** for constructing a first alternative embodiment, **FIG.** [8] 7 a tapered triangle **12** for constructing a second alternative embodiment, and **FIGS.** [9and 10] 8 and 9 show strutted frame elements **13** and **14**, respectively, for constructing third and fourth alternative embodiments, respectively, of the geodesic structure according to the present invention. **FIG.** [11] 10 shows a partial view of the second alternative embodiment of a dome **200** constructed of the tapered triangular elements **12** and a skin **17**. Each triangular element **12** has a wide end **12A** and a narrow end **12B**. The elements **12** are arranged such that each element **12** is touching adjacent elements **12**, with the narrow end **12B** facing in toward the center of the dome **200** forming the concave inner surface and the wide end **12A** forming the outer convex surface. The first alternative embodiment according to the present invention uses the tapered cones **11**, is constructed similarly to the dome **200**, and is also covered with a skin.

**[0055]** **FIG.** [12] 11 shows a partial surface of the third alternative embodiment according to the present invention of a dome being constructed with the strutted

frame elements **13**. The elements **13** are hexagonal in shape and comprise three struts **13A** that are crossed in the center so as to form the hexagonal shape. A tension element **15** forms the perimeter of the strutted frame element **13** and is fastened with sufficient tension to force the struts **13A** into a slightly bowed or convex-concave configuration. In this third alternative embodiment, strut ends **13B** protrude beyond the perimeter of the strutted frame element **13**. Adaptable couplers **16** are used to couple two strut ends **13B** of two adjacent strutted frame elements **13**. A plurality of frame elements **13** can be connected to form a sphere having the dome angle **θ** corresponding to the dome angle **α** of the strutted frames **13**. The dome constructed of such elements is then covered with a skin, similar to the dome **200** described above.

**[0056]** **FIG. [13]** <u>12</u> illustrates a very simple type of adaptable coupler **16**, which is a tube, open at both ends. The strut ends **13B** of two different strutted frame elements **13** can be inserted into the coupler **16**. The coupler **16** is long enough to slidably hold the strut ends **13B** within the coupler **16**, yet allow the strut ends **13B** to slidably adjust the position of the strutted frame elements **13** in place within the structure under construction. Many types of adaptable couplers **16** are available and suitable for holding the strutted frame elements **13** in a proper relationship to the other strutted frame elements **13** in the structure. Suitable couplers include clamps or tubes with holes or slots through which set screws or locking pins are insertable to hold the strut ends **13** in position.

**[0057]** [FIGS. 14] <u>FIG. 13</u> illustrates a fifth embodiment of the invention, a map **500** of the earth. For purposes of illustration only, Oslo, Norway is the major point of interest on the map **500** and is located somewhat near the center of the map **500**. The intended application of the map is to illustrate travel routes from Oslo to other points in the world. Initially, orthogonal projections of places of major interest are projected onto a sphere, each place of major interest surrounded by vertexes **18**.

Attention is given not to place the vertexes **18** on areas of particular interest, but instead, to place them in areas of lesser interest, with respect to the particular focus of the map **500**. Connecting lines **19** are drawn on the sphere to connect the adjacent vertexes **18.** The resulting pattern made by the connecting lines **19** shows that the map **500** is omni-triangulated and that the triangles vary in size and are in some instances scalene triangles. The map **500** is then cut along some of the connecting lines **19** to allow the map **500** to lie flat. The map **500** has very little distortion, as the entire map is constructed of cartographic images of limited sections of the earth taken as orthogonal views.